INTERNATIONAL JOURNAL OF
CURRENT MULTIDISCIPLINARY STUDIES
Available Online at http://www.journalijcms.com
Vol. 3, Issue,03, pp.674-676, March, 2017

IJCMS

RESEARCH ARTICLE

MUTUAL COUPLING REDUCTION IN PRINTED MONOPOLE ANTENNA USING EBG STRUCTURE

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ARTICLE INFO

Received 22nd December, 2016
Received in revised form 24th January, 2017
Accepted 5th February, 2017
Published online 28th March, 2017

Keywords:

Printed Monopole Antenna, Mutual Coupling & Electromagnetic Band gap Structure.

ABSTRACT

In this paper, mutual Coupling reduction in Printed Monopole Antenna with Electromagnetic Band gap Structure has been investigated. Printed Monopole antenna is basically printed Micro strip antenna with etched ground plane for multi-band application. In Particular we have designed at 5.8GHz frequency which is applicable in wireless communication. Thus, for 3D Electromagnetic simulation of high frequency components, ZelandIE3D software is used. The objective of this paper is to reduce mutual coupling in 2 element rectangular printed monopole antenna array with EBG structure and compare various parameters such as mutual coupling, return loss etc without EBGstructure.

INTRODUCTION

Electromagnetic Band gap Structure had deserved much attention for mutual coupling reduction in recent years. EBG structured materials belong to a class of artificial periodic meta materials which prohibit electromagnetic waves propagation within a particular frequency band [5&6]. There are many forms of EBG structure. It has 2 important band gap features: a) surface wave suppression and b) in-phase reflection coefficient. Surface wave suppression increases gain of antenna and reduces back radiation whereas in-phase reflection feature leads to low profile antenna design. Also EBG have other advantages such as

- Ultra wideband (greater than 80%) relative Bandwidth.
- Compatibility with existing circuit board technology.
- Excellent insertion loss and impedance matching characteristics.
- Negligible crosstalk and radiation.

Mutual Coupling affects antenna parameters where coupling comes from 2 paths [3&4]. First is due to free space radiation and other one is because of surface wave. In this paper, we have described reduction of mutual coupling in printed monopole antenna by concentrating on the surface wave suppression effect of the EBG structure.

Printed Monopole Antennas

Here FR4 substrate with dielectric constant 4.4 and height 1.6mm is used. As compared with other substrates FR4 has higher dielectric constant which results in a smaller patch size. Calculation of the width (W):The width of the Micro strip patch antenna is given by

$$W = \frac{1}{2f_r\sqrt{\mu_0\varepsilon_r}} \times \sqrt{\frac{2}{\varepsilon_r + 1}} \quad \text{……….(1)}$$

Effective Dielectric constant is calculated as:

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + \frac{12h}{W}\right)^{-1/2} \quad \text{……….(2)}$$

By substituting We can get εreff.

The effective length is calculated as

$$L = \frac{1}{2f_r\sqrt{\varepsilon_{eff}}\sqrt{\mu_0\varepsilon_0}} - 2\Delta L \quad \text{……….(3)}$$

Design, Simulation And Experimental Results

Electromagnetic Band gap Structure has received great attention among researchers all over the world because of its immense civilian and defense applications. EBG materials are periodic structures, whose name derives from their property of

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preventing light propagation at same wavelengths. In this section the rectangular patch array antenna is designed using Zeland IE3D Software. The design layout of 2 patches rectangular Micro strip patch antenna array with and without EBG structure are illustrated in figures.

Figure 1 shows printed monopole antenna without EBG structure. In this we have simulated simple two monopole antenna without EBG structure and displayed various parameters like return loss, mutual coupling and current distribution. In order to design the proposed structures and optimize their dimensions for specific operating frequencies, a CPW line excitation is employed. This type of excitation allows for an efficient design of the proposed structures without the need of incorporating complex antenna geometries.

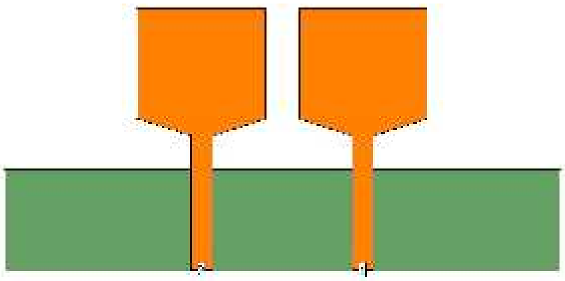

Fig1 Design layout without EBG structure

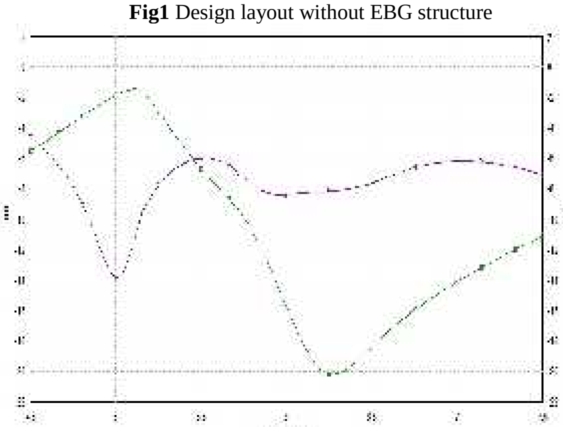

Fig 2

Return Loss and MutualCoupling without EBG structure

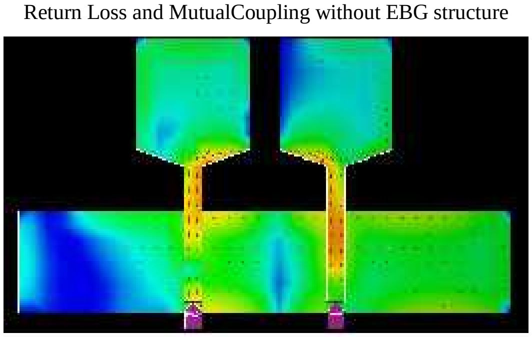

Fig 3 Current Distribution without EBG structure.

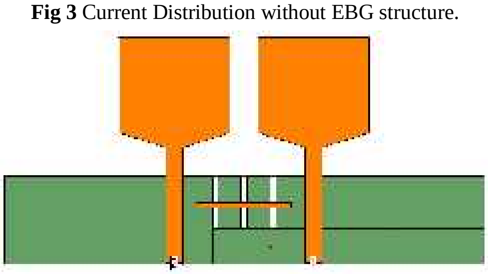

Fig4 Design layout with EBG structure

Figure 4 shows design layout of two printed monopole antenna with EBG structure which we have simulated to get better results as compared to the design without EBG structure.

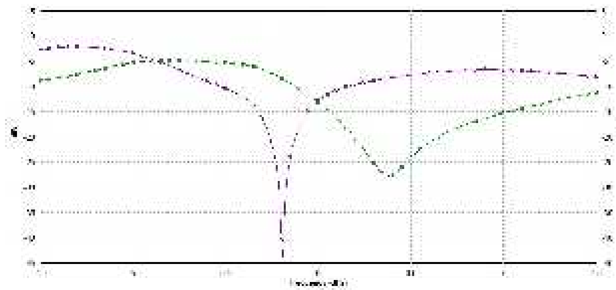

Fig 5 Return Loss and Mutual Coupling graph with EBG structure.

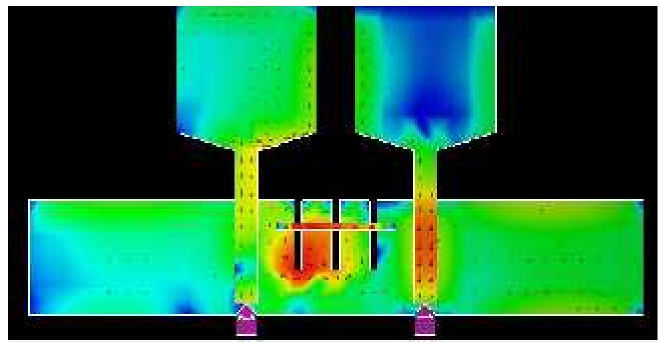

Fig 6 Current Distribution with EBG structure.

Table1 Comparative study

Design	Return Loss	Mutual Coupling	Current Distribution
Without EBG	-13.84	-1.83	Bad
With EBG	-41.64	-8.41	Good

From the Table 1, the performance of two element monopole antenna array with EBG structure is better than monopole antenna without EBG structure. From table it is clear that return loss has been increased in monopole antenna array from -13.84dB to –41.64 and mutual coupling is also improved from -1.83dB to -8.41dBwhen EBG structure is applied.

CONCLUSION

In this paper, we have investigated printed monopole antennas, which is basically a printed micro strip antenna with etched ground plane for 5.8 GHz applications. Unlike monopole antennas which have non-planar or protruded structures above the ground plane, Printed monopole antennas are less fragile, planar and can be integrated with the integrated circuits. A two element printed monopole antenna wit EBG structure at the frequency of 5.8GHz has been successfully designed.

In particular, we have fabricated and tested printed monopole antennas 5.8GHz applications. The proposed technique is based on the insertion of EBG structures on the common ground plane. Also, simulation results have been validated with measurements. In modern wireless communication system antenna play very important role. Good design of antenna can improve performance of system. Further work can be done EBG structure on metamaterial. The recent interest is on metamaterial technology and application of EBG(Electromagnetic Band Gap) structure in the field of electromagnetic wave engineering utilizing this technology we can improve noise suppression and interference control.

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